

第 94 回定例研究会 講演 OHP

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**On Decarbonization, Hydrogenation and Dematerialization  
Recent Energy Technology Developments in Europe \***

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**From Fossil Fuels to Energies-of-Light**

- "Invisible Oligopolization" of World Fossil Resources
- Switch from Coal to Oil to Natural Gas and Further to Energy Efficiency, Renewable Energies, Hydrogen as an Energy Carrier
- Decarbonization, Hydrogenation, De-Materialization
- Energies-of-Light: Are of Light Weigth, Utilize the Light of the Sun, Lightens the Environmental Burden, Shed Light into the Energy Future
- "Technologies Compete, not Energies" (D.S. Scott)

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### **Growing Reluctance to Use Nuclear Fission**

- France: Super Phénix' Close-Down Decided
- UK: No Private Money for British Nuclear Park
- Germany: Discontinuation of Plutonium Extraction **Business** and Termination of Nuclear Operations under **Negotiation**
- Swiss Government Decided to **Postpone National Capacity Enlargement**
- **East Europe: Chernobyl as Omen**
- **Worldwide 1700 Tons of Plutonium in Stock plus 50 Tons/yr: No Final Solution Visible**

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### **Market Liberalization**

- Landslide Decline of Electricity Prices
- "Green" Electricity Traders Gained Access to Grid
- Green Electricity Market's Yearly Growth 20 - 30 %
- Solarthermal Installations + 30 %/yr
- Wind Energy 8 GW<sub>e</sub>(1998) Worldwide: A Success Story
- German Federal Government: Subsidy for 100.000 Photovoltaic Roofs Program Planned

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### Transport I

- Renaissance of European Rail System
  - Super-Fast Intercity Transport at 300 km/h and above
  - Interchange of Fast- and Light-Rail-Systems with Public Road Transport
  - Channel Tunnel in Operation
  - Two Tunnels under the Alps decided
  - Two Bridges Connecting Danmark and Sweden in Operation / under Construction
  - Extension of Modern Rail Systems into East Europe

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### Transport II

- Germany's Transport Future Fuel Strategy (Verkehrswirtschaftliche Energiestrategie (VES)), VES Start: 1997; Pilot-Infrastructure and Pilot-Fleet in Operation early next Decade
  - Less Future Major World Oil Fields, from 15 to 5
  - Oil Field Operations in Potentially Politically Unstable Regions
  - Ongoing Worldwide Automobiliation, 600 million to date plus 50 million/yr new
  - No Brake-Block for Continously Rising CO<sub>2</sub>-Emissions
  - Decarbonized Fuels Potential: Electricity, Methanol, Hydrogen, . . .

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**Transportation III**

- BMW to put on the Road in 2000 a Pilot Lot of Gasoline Fueled 7-Series with ICE and SOFC-Power Plant for On-board Electricity and Heat Supply
- As Part of its EXPO-2000 project »Clean Energy: Drive by Sun and Water«, BMW plans for a Pilot Lot of LH<sub>2</sub>-fueled 7-Series with ICE and PEMFC-Power Plant for On-board Electricity and Heat Supply
- DaimlerChrysler, Shell, RWE and Icelandic Authorities to study Pilot Transport of Hydrogen as an Export Vector for Iceland's Hydro and Geothermal Sources to Europe
- The German Federal Office for the Environment published (8 March 1999) Results of a Comparison of Environmental Impacts on an entire Energy Conversion Chain Basis (well-to-wheel) of ICE- and FC-vehicles. In the Near Term, other than for Stationary Applications, no significant Environmental Advantage of FC-Vehicles over ICE-Vehicles seen

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**R,D + D**

- Some 10s of Phosphoric Acid Demonstration Fuel Cells Operable
- Pilot Molten Carbonate Fuel Cell in Bielefeld under Construction
- Two Robot H<sub>2</sub> - Filling Stations each, one in Hamburg (GH<sub>2</sub>) and Munich (LH<sub>2</sub>), in Operation
- Offshore H<sub>2</sub> - Production from Natural Gas and Re-Injection of CO<sub>2</sub> Underground the North Sea off Norway
- In Stuttgart: Experiments on CO<sub>2</sub> Concentration from Dilute Sources and Combination with Renewable H<sub>2</sub>
- DaimlerChrysler / Ballard to bring PEM Fuel Cell Powered Vehicle on the Market early in the next Decade

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**Report on National Initiatives**

- EU's White Paper "Renewable Energy: Energy for the Future" foresees Doubling of Renewables' from 6 to 12 % by 2010
- EU allocated quotas based on Kyoto Result to Cut Greenhouse Gas Emissions 8 % by 2008/12 among Nations: Germany 21 %, Britain 12.5 %, France 0 %, . . .
- Switzerland to Complete National Plan E 2000 with 3 % Heat and 0.5 % Electricity from Renewables by 2000; E 2000-plus envisaged
- The "2000 Watt - Society" made Sustainability Guiding Target of Swiss University System
- In Germany, Investments for c. 40 % of PV World Market under way ( 1997 c. 120 MW<sub>e</sub>)
- Deutsche Shell to spend US-\$ 500 million over the next 4 years on Renewables
- France: A National Hydrogen Energy Society Established
- EXPO 2000: HYFORM 2000 - The International HYDROGEN Energy Forum 2000 will be held in Munich, Germany

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**Germany**

- 82 million Inhabitants, 1,4% of World Population, 4% both of World Energy Demand and GHG Emissions
- 500 million tce
- Indigenous Sources: Plenty of Brown Coal, Hard Coal 4x as Expensive as World Market Price, no Oil, less than 20% Natural Gas, no Uranium, very little Hydropower
- More than Two Thirds of Demand imported, Worldwide Distribution of Suppliers
- Nat'l Energy Efficiency ~30%, Nat'l Exergy Efficiency 15,9%: Doubling Technologically Possible
- Residential and Commercial Buildings: Drastic Reduction of Specific Energy Demand from 300-400 kWh/m<sup>2</sup> yr to 30-40 kWh/m<sup>2</sup> yr (Low Energy Standard).
- Insolation 110 W/m<sup>2</sup> and 1000 kWh/m<sup>2</sup> yr
- Wind 2,5 GW<sub>e</sub> On-line, Overall Potential 4-5 GW<sub>e</sub> On-shore and Off-shore
- C. 40 MW<sub>e</sub> PV Production Capacity in Operation or under Construction
- So far, Insignificant Biomass or Ambient Heat (Heat Pumps) Utilization, very little Geothermal, on Principle no Oceanthermal or Tidal or Wave Energy Potential

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**On Climate Change: Recommendations of the German Bundestag's Enquête Commission »Protection of the Earth's Atmosphere« to Parliament and Federal Government**

■ By 2020

Double the Nat'l Energy Efficiency from 30% to 60%  
Cut the Carbon Usage of Fossil Energy by Half

■ By 2050

Reduce Fossil Fuel Demand to 25% (today 87%)  
Increase Renewable Energies' Utilization to 25% (3-4%)  
Supply 50% by Import of Renewable Energy (~0%) and/or Nuclear Energy Utilization (11%)

Three of these Recommendations have to do with Hydrogen: Cut of Carbon Usage, Increase of Indigenous Renewables, and Import of Renewable Energy.

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**Conclusion: Europe's Response and Policy Development to Fossil Fuel Depletion and Climate Disruption Risk**

- Growing Reluctance to use Nuclear Fission
- Tendency towards Ecotaxation
- Technologies Turn the Balance for Decarbonized, Hydrogenated, and De-materialized Energies, finally for Hydrogen as Energy Carrier
- Bridging from Fossil Fuels' "Consumption" to Use of Energies-of-Light
- Shift in Significance from the Beginning of the Energy Conversion Chain to its End, from Primary Energy Supply Driven to Technologies' Driven Energy Services
- More Exergy from Energy, Less Energy
- For Industrialized Countries: Tendency to Re-Nationalize Energy through Efficient Conversion Technologies Lessens Energy Raw Material Import Dependence
- Open Question: Energies-of-Change Financially Affordable in Time ? ?

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